The invention of computers has enabled complex machines like Computer Axial Tomography (CAT) scanners to be built. These have an X-ray generator that is mounted in such a way that it can be moved right round the body. It takes X-ray images as it moves and a computer converts the data to three-dimensional images of the inside of the body. Roentgen had used a fluorescent screen in his first experiments which provided 'live' images rather than a photograph. This technique is still used and is now called 'fluoroscopy'. It is often used to examine patients with digestive system problems, previous learning and the mass media. This transfer seems to result in more or less firm mental models, although often not internally consistent or coherent.

Based on our research on pre-med students' models of X-rays we designed a hands-on lab using semi-transparent Lego bricks to model CAT scans. Without "surgery" (i.e. without intrusion into the Lego "body") students determined the shape of an object, which was built out of opaque and translucent Lego bricks and hidden from view. A source of light and a detector were provided upon request. Using a learning cycle format, we introduced CAT scans after students successfully have completed this task. By comparing students' ideas before and after teaching interview with the groups of 2 or 3 participants, we have investigated transfer of learning from basic physics and everyday experience to a complex medical technology and how their peer interactions trigger and facilitate this process.

During the last phase of our research we also introduced a CAT-scan simulation problem into our teaching interview routine and compared students' perception of this simulation and their perception of the hands-on activity.

**Keywords:** physics education; X-rays; CAT-scans; mental models; transfer of learning; medical physics

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**Dissertation**
Computed tomography (CT) is a well-known imaging technique that allows for non-invasive visualization of the interior of an object. It is widely used in many applications such as medical imaging [22], [23], non-destructive testing [24], industrial metrology [25], food industry [26], [27], and security [28]. If indeed many X-ray projections from all angles are available, FBP generally leads to high quality reconstructions. If these two conditions are not satisfied (e.g. in case of limited angle scanning or related missing data problems), severe streaking artefacts appear in the reconstructed image. In the near future the medical imaging industry in general and CT reconstruction in particular moves to a new level with the approval of Machine Learning techniques and their amazing outcomes. 

Introduction

Tomography refers to the cross-sectional imaging of an object from either transmission or reflection data collected by illuminating the object from many different directions. The impact of this technique in diagnostic medicine has been revolutionary, since it has enabled doctors to view internal organs with unprecedented precision and safety to the patient. The aim of computerized tomographic imaging is the same as with x-rays, viz., to reconstruct the cross-sectional image of, say, the attenuation coefficient.